A LOCAL WEATHER SIGN.

Almost every locality in the world has some special local weather sign, although these are not always recognized by the ordinary observer. We refer to signs that are rational and depend upon the physical properties of the atmosphere; and it is not derogatory to the reputation of the local weather prophet to study out and make use of these signs when he endeavors to make local weather predictions better than the general forecasts of the Weather Bureau. For a long time the audibility of sounds at a distance, or the visibility of distant objects, or the occurrence of mirage, have all been known to indicate special quiet and homogeneous conditions of the atmosphere, such as precede local disturbances. The explanation of the connection between these signs and the resulting phenomena involves the consideration that the air is peculiarly opaque to light and sound when it is a mixture of warm and cold currents, and is transparent to these when the distribution of temperature and moisture is very uniform. Thus, the English observers have for a century past recorded the visibility of objects and the audibility of sounds as indicative of approaching rain. The following interesting item may refer to some similar phenomenon, or it may possibly be that the roaring noise here described is produced by the wind blowing over the top of the mountain and forest before it has as yet reached the lowlands and distant observers. It is quite common for the wind to blow strongly night and day overhead while at the earth's surface it is calm at night but windy by day. This was explained by Espy as being due to the fact that during the daytime the sun warmed the ground and the adjacent air, which, therefore, rises by buoyancy and lets the rapid wind overhead descend to the earth's surface; whereas during the night-time the ground and the adjacent air are cold, therefore they do not rise, and the rapid upper winds flow overhead without descending to the ground. Whatever may be found to be the true explanation, it is evident that the phenomena observed at Waynesville, Haywood County, N. C., are worthy of study by the observers in that neighborhood, and the following extract from the Waynesville Courier is worthy of permanent record:

The Shewbird Mountain, 4 miles south of town, is to us the strangest thing in this whole mountain country. The mountain is full of large, rough cliffs, and by its peculiar shape and position serves as a weather signal to the people for miles around, because, as the general saying is, "when old Shewbird begins to roar you may prepare for rough weather." It generally commences about dark, and continues to roar until the rain or snow comes, which may be five hours or it may be ten. At dark the air may be perfectly still and not a cloud in sight, yet the mountain may begin to roar, and you may know that by the next morning the bad weather will be on hand. Though the mountain is 4 miles away, the roaring sounds like that made by a loaded freight train half a mile distant, and it is a continuous sound, too, with no intermission.

CLIMATOLOGY IN CALIFORNIA.

The report of the California section for June, 1900, contains a brief comparison by Mr. McAdie of the relative climates of the Weather Bureau stations in San Francisco and on Mount Tamalpais to which we must refer for many details. Mr. McAdie says:

The highest temperature recorded on the mountain was 96° on July 18, while on the same date the maximum temperature at San Francisco was 66° and at Point Reyes Light, 52°. The highest temperature recorded at San Francisco during 1899 was 94° on October 8, while on the same date the maximum temperature on Mount Tamalpais was 88° and at Point Reyes, 74°. The lowest temperature recorded during the year on the mountain was 23° on February 4, and on the same date at San Francisco and Point Reyes, 34°. During the summer months there is very frequently a cooling of 11° at the lower station according to the prevalence of fog. The mean relative humidity for the whole year is 59 per cent on the mountain and 83 per cent at San Francisco. This dryness is especially noticeable during the summer months, and is doubtless the cause of the agreeable change of climate noted by visitors. The maximum wind velocities are 91 miles on the mountain and 47 miles in the city. The total annual wind movement was 177,000 miles at Mount Tamalpais and 96,600 at San Francisco; the mean annual pressure was 29.87 and 27.55 inches; the mean annual temperature 54.9° and 55.7; mean annual dew-point, 48° and 36°; total annual rainfall, 23.23 and 36.86 inches, at the lower and upper stations, respectively.

METEOROLOGICAL CONDITIONS FAVORABLE TO SPONTANEOUS COMBUSTION.

Every meteorological or climatological condition that can affect the welfare of mankind comes under the consideration of the Weather Bureau, no matter whether explicitly mentioned in the acts of Congress or merely implied in general.

In the June report of the Ohio section, Mr. J. Warren Smith calls attention to the fires that are started by the spontaneous combustion of hay. Spontaneous combustion, whether of hay, cotton, oil and waste, or any other substance, becomes imminent only under certain atmospheric conditions as to temperature, pressure, and moisture. The heat caused by the oxidation of the oil in cotton waste or rags, or that caused by fermentation in moist hay and other substances, does not give rise to flame unless the temperature of the whole mass is above a certain limit, which is as yet ill defined. In general, spontaneous combustion is not to be feared if the fresh supply of oxygen from the atmosphere is cut off. If the inflammable substance is confined within a non-conducting inclosure, such as the interior of a bale of cotton or a tight room or a closed box, its temperature may attain a point surpassing the point of ignition, but danger does not occur until the inclosure is opened and a fresh supply of oxygen is suddenly admitted when, of course, everything breaks out in flame. The best preventative of spontaneous combustion is a rapid and complete ventilation, by which means the oxydizing and fermenting substances are kept cooled down below the point of ignition. Mr. J. Warren Smith states—

That the fermentation within moist hay may raise the temperature to 374° F., and that careful tests show that clover hay actually does ignite at temperatures approximately the same as this. He particularly requests that all details as to actual cases of spontaneous combustion may be sent to him for further investigation.

WEATHER BUREAU SERVICE IN HAITI.

In connection with the improvement of the West Indian branch of the Weather Bureau service, we take pleasure in recording the very material assistance received through the active cooperation of Hon. W. F. Powell, United States Envoy Extraordinary and Minister Plenipotentiary at Port au Prince, through whom our Government has received from the Haitian Government the free use of its telegraph service in aid of this important work. At first the request of the Weather Bureau for permission to establish a meteorological and telegraph station at Mole St. Nicholas was declined, but after some delay the government gave consent to the establishment of an observatory at Cape Haiti. Unfortunately the immediate establishment of this important station was temporarily delayed for the want of the necessary funds. Meantime negotiations with the cable company and the Haitian Government land service led to an arrangement by which the cable expenses are paid by the Weather Bureau but the receipt and distribution of all observations and forecasts throughout Haiti was assumed by the Haitian Government, whose cabinet stated through its minister, Mr. St. Victor, "that the government grants to the United States the use of its telegraphic service free of all cost to the Weather Bureau," and added, "that it is glad to render this aid to our Government in the establishment of such an important work." It is understood that advisory messages and hurricane warnings will be disseminated and hurricane signals displayed in Haiti the same as in the other West Indian Islands, beginning July 1, 1900. This information as to hurricanes will be available at the offices of the United States consuls, vice consuls, or consular agents, whenever such officials are available.

THE LAWS OF ATMOSPHERIC CIRCULATION.

A year ago, Prof. V. Bjerknes read before the German Association of Scientists, at Munich, a memoir on dynamics as applied to the circulation of the atmosphere, in which certain principles are developed that undoubtedly apply to many atmospheric movements although probably not to all of them. This memoir is the third that Professor Bjerknes has published on this subject, and one of his pupils, Mr. Sandstrom, has further developed the subject and applied this new method to a discussion of the American storm of September 21–24, 1898. The Editor is preparing to publish a complete translation of both these papers in order to make them available to American students. Meantime the following notice of the work of Professor Bjerknes is copied from Nature June 28, 1900, vol. 62, p. 200, and will give the reader a general idea of the considerations introduced into this latest effort to investigate the motions of the atmosphere in the light of rigorous mechanical laws:

The dynamical principle of atmospheric circulation is treated by Prof. V. Bjerknes in the Meteorologische Zeitschrift, March and April, 1900. Starting with the property that the circulation theorems of abstract hydrodynamics (according to which the circulation in any circuit formed by the same particles is constant) only hold good when the pressure is a function of the density alone, Professor Bjerknes points out that in the atmosphere this condition is not satisfied, owing to local differences both in the temperature and in the degree of moisture present in the air. Of these two causes the first seems to be the most important. The conception of "solenoids" is then introduced, a solenoid being an elementary unit tube bounded by pairs of consecutive surfaces of equal volume and equal pressure, respectively. The fundamental proposition in connection with circulation asserts that the rate of change of the circulation in any circuit is proportional to the number of solenoids inclosed by that circuit. A number of diagrams are given representing the cases of land and sea breezes, trade winds, local upward currents, hill and valley winds, cyclones, and anticyclones. The omission to take account of the extra complications arising from viscosity and terrestrial rotation probably prevents these investigations from being utilized for calculations in connection with weather prediction; and for this reason Professor Bjerknes' theory must be rather regarded in the same light as other dynamical theories of physical phenomena, in which certain simplifications not occurring in nature are made in order to bring the calculations within the range of mathematical analysis. But it is only by the aid of such simplifications that order can be evolved out of the chaos of statistics furnished by the experimentalist.

Prof. V. Bjerknes, of Stockholm, is the son of Prof. C. A. Bjerknes, of Upsala, and has lately published the first volume of the collected memoirs of his father. [1] These memoirs bear especially on very important theorems in the motion of fluids and have been by him applied especially to the movements of spheres in liquids whence resulted an apparent explanation of the force of gravity, the attractions of molecules, and many correlated phenomena. In order that our readers may have some knowledge of the general character of the work of Prof. C. A. Bjerknes, we append the following review of this first volume of lectures, as published by Prof. Carl Barus, at page 395 of the Journal of Physical Chemistry for May, 1900:

Among the attempts to explain the nature of force in terms of the medium through which it acts, those based on the hydrodynamics of an incompressible frictionless fluid seem most at hand, inasmuch as the inevitable ether is given as such a fluid at the outset. The irrotationally moving fluid surrounding a vortex has been used as a field of this kind by Kelvin; and J. J. Thomson has shown at length that whereas stable groups of aggregated vortices are possible up to eight in number, beyond this all grouping becomes unstable, thus suggesting close relations to atomicity. The technical difficulties in the way of the vortex hypothesis have barred its progress. On the other hand, the vibratory and pulsating theory, which had an independent origin throughout and need not be incompatible with the former, has now many achievements in its favor. That force can be derived from the impact of a wave train in evidence by the radiometer, but the mechanism of this apparatus is too complex to be suitable. Kelvin showed that waves lash the boundary of the medium with a pressure per square centimeter equal to the product of half the density of the medium and the square of the wave velocity. Mayer's famous experiment, with pivoted resonators rotating in the acoustic field of their own notes, was shortly after its discovery explained by Raleigh, proving that the internal pressure in a resonator exceeds atmospheric pressure, so that a force exists at the mouth directed normally inward.

Long before all this, before Faraday had proclaimed his doctrine of lines of force, and before Maxwell had developed that doctrine, indeed, almost before Kelvin had published his method for the solution of hydrodynamic problems by Hamilton's principle, the elder Bjerknes had, independently, become dissatisfied with "action at a distance," and had tentatively suggested a remedy. As far back as 1868, (Maxwell's great treatise was completed in 1873) with the simplest of media (frictionless, incompressible fluid) and the geometrically simplest solid, (a sphere) Bjerknes had found that the force actuating the center of one of two spheres, and arising in a second moving sphere, has the same intensity and direction as if the former were absent, and is equal to the acceleration in question, multiplied by three-halves of the medium displaced by the first sphere, certainly a suggestive proposition, though it did not then predict Newton's third law. Meanwhile Kirchhoff had adopted Kelvin's hydrodynamic method, and had developed it for problems of precisely the present kind, with his usual ability. Bjerknes was then able to apply the Kelvin-Kirchhoff investigation to his own researches with such success as not only to deduce the law of action and reaction as a necessary property of his own mechanism, but to show that pulsating spheres act on each other through the medium by stressing it into a field of force, *mutatis mutandis*, identical in character with the action on each other of magnetic or electrical molecules.

These papers have been much sought after by physicists, in spite of their inaccessibility, and the fact that demonstrations were often withheld. It is therefore fortunate that the younger Bjerknes, an equally able investigator, has collected the work of his father in a systematic treatise, of which the first volume is now before us. As above indicated, the book treats at length of the motion (vibration, translation) of a system of spheres of variable (pulsating) volume submerged in the ideal fluid stated, preliminarily to deriving action at a distance from purely hydrodynamic phenomena. This book is, therefore, not without interest to the chemist, for the behavior of molecules imbedded in ether is precisely such as falls within the scope of Bjerknes' investigation.

It would be going too far to examine the work in detail, and such an examination, without mathematics, would be most unsatisfactory. Investigations like the present are usually made by deriving the particular equations of motion, and then so transforming them that they may be identical in character with those of the known phenomenon which it is aimed to explain. The remainder of the work is an interpretation of corresponding terms, parameters, and constants. Suffice it to add, therefore, that in 1878 Bjerknes investigated the condition of rotational stability of the axis of permanent oscillation of spheres in an oscillating medium, and found both a pulsating pair or a single oscillating sphere to be subject to torque, the final link in his argument.

A reexamination thus reveals that Newton's first, second, and third laws have all been deduced, inclusive, of course, of inertia. Hydrodynamic forces may be superposed, which is a predication of vector summation. They are independent of the velocity of the body actuated. The system admits of concealed motions (potential energy); it is subject to the law of the conservation of energy, and its potential is subject to Laplace's equation. In a general way hydrodynamic forces vary as the product of the volumes (ultimately masses) of mutually reacting spheres. Specifically, two identically pulsating spheres attract each other, two oppositely pulsating spheres repel each other, with a force varying as the density of the medium and the intensity of pulsation, and inversely as the square of their distance apart. Furthermore, action of magnetic character (attraction, repulsion, rotation) occurs between oscillating and pulsating systems. Finally, heavy spheres of opposed pulsations attract each other at long ranges and repel each other at short ranges, with a position of stable equilibrium for an intermediate range. The converse holds for spheres lighter than the medium.

It is hardly necessary to give further examples of the contents of this remarkable book. The author has been gracious in collecting the chief dynamic and hydrodynamic principles in the introduction, for the convenience of the reader, but a good working knowledge of applied mathematics is necessarily presupposed.

[1] Vorlesungen über hydrodynamische Fernkräfte, nach C. A. Bjerknes' Theorie. By V. Bjerknes. Band I. 17 by 26 cm., pp. xvi, 33 S. Leipzig: Johann Ambrosius Barth, 1900. Price: paper, 10 marks.